Center Innovation Fund: JSC CIF

High Efficiency, Deployable Solar Cells

Completed Technology Project (2012 - 2013)

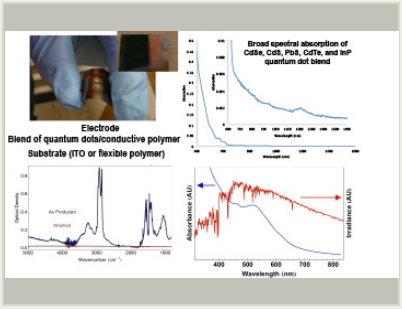
Project Introduction

Ultrathin, lightweight, flexible, and easily deployable solar cell (SC) capable of specific power greater than 1kW/kg is the target of this development and are at an early stage of development for NASA's future missions. Quantum dots and carbon nanostructures are employed, along with conducting polymers. The achievement of a broad photovoltaic spectral absorption is desired to yield high efficiency and power density. The unique optical absorption properties of quantum dots and the high conductivity of carbon nanostructures will allow the solar cell to operate at voltages greater than the bandgap of traditional photovoltaic materials.

To date, initial, rudimentary optoelectric devices have been successfully fabricated. Devices were first fabricated on rigid substrates for ease of manufacture. These devices show enhanced photoconductivity, indicative of efficient photo-excitation and charge transfer between the QDs and polymer, which is crucial for the production of solar cells (SCs) from these materials. Plots of the current versus voltage are used to characterize the operation of SCs. The total film resistance decreases under illumination because photo-excited carriers are efficiently separated at the interfaces between the polymer and QDs. Device fabrication was then executed on flexible substrates. The optical absorptions of quantum dot/polymer blends were observed under ultraviolet illumination and the photocurrent responses were observed to be similar to that of the devices fabricated on the rigid substrates. Next steps include investigation of other conductive polymer systems. Optimization of blends containing ligand-stripped QDs will be sought. Uniform dispersion of the QDs into the conductive polymer is necessary. The optimal QD/conductive polymer system will be selected and design of the appropriate novel architecture will commence. The first approach will be the fabrication of multi-junction layers, followed by the design of patterned structures. Architectures will be designed in order to optimize photoabsorption, improve charge separation, and increase charge extraction.

Anticipated Benefits

The proposed technology meets the need for high power, high voltage, autonomously deployable surface solar arrays needed to generate reliable electric power. Deposition of flexible layers on a flexible substrate and elimination of the typical rigid substrate allows for compact stowage and subsequent deployment in partial gravity. Furthermore, the flexibility and versatility of this SC architecture make it readily augmented for use on an irregular surface, in a dusty environment, for extravehicular activities, and possibly for dust mitigation.



Project Image High Efficiency, Deployable Solar Cells

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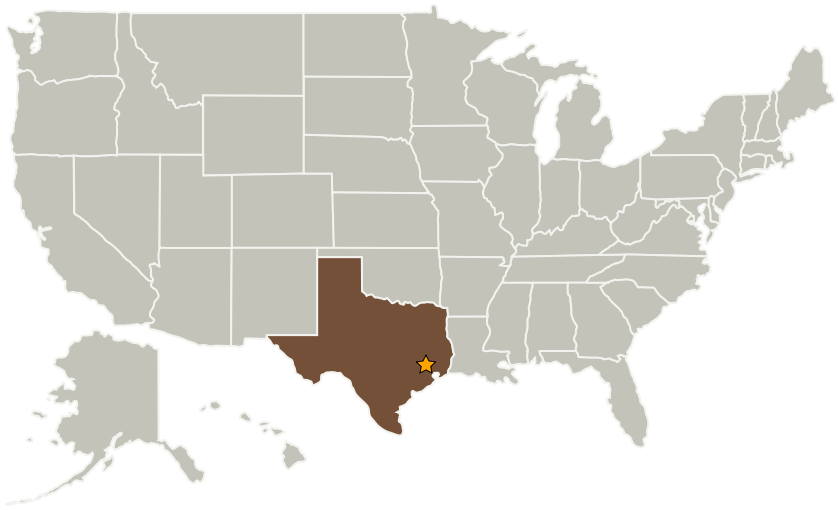

Organizations Performing Work	Role	Type	Location
★Johnson Space Center(JSC)	Lead Organization	NASA Center	Houston, Texas

Primary U.S. Work Locations
Texas

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Johnson Space Center (JSC)

Responsible Program:

Center Innovation Fund: JSC CIF

Project Management

Program Director:

Michael R Lapointe

Program Manager:

Carlos H Westhelle

Project Manager:

Maryjane E O'rourke

Principal Investigator:

Maryjane E O'rourke

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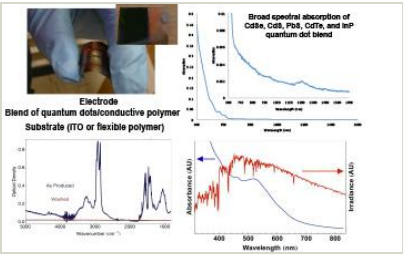
Images



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Project Image High Efficiency, Deployable Solar Cells
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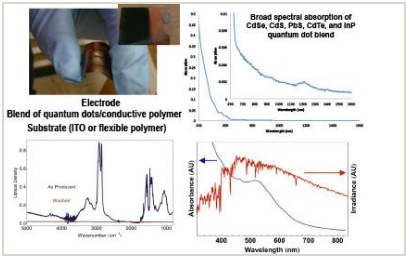

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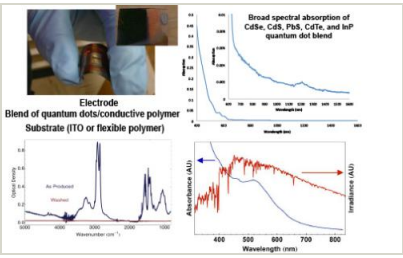

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Project Image High Efficiency, Deployable Solar Cells
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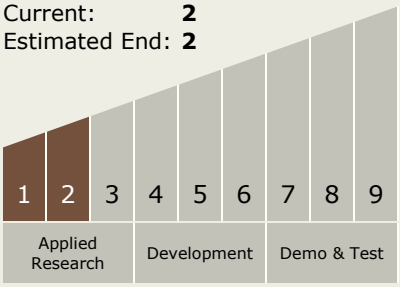
Links

NTR 1
(http://Not yet established.)

Technology Maturity (TRL)

Start: **1**
Current: **2**
Estimated End: **2**



Technology Areas

Primary:

- TX10 Autonomous Systems
  - TX10.3 Collaboration and Interaction
    - TX10.3.4 Operational Trust Building